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THE FOX NUCLEAR, BIOLOGICAL, AND CHEMICAL RECONNAISSANCE SYSTEM: LESSONS-LEARNED FROM A FOREIGN NON-DEVELOPMENTAL ITEM ACQUISITION

by

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Non-developmental Item acquisition represent a viable approach to meet procurement needs of the Defense Department. The reduced acquisition cycle times and resultant cost savings of this acquisition strategy presents significant potential benefits to DoD. One weapon system program that has succesfully used such an NDI strategy is the U.S. Army's Fox Nuclear, Biological, and Chemical Reconnaissance System. This thesis examines the DoD acquisition process and how NDIs are used within the process. The thesis then examines the Fox Program and its NDI Acquisition strategy to determine what factors made the program successful. From this analysis, lessons-learned are identified that can be used by other acquisition managers and their staffs effectively to manage future NDI programs.

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THE FOX NUCLEAR, BIOLOGICAL, AND CHEMICAL RECONNAISSANCE SYSTEM: LESSONS-LEARNED FROM A FOREIGN NON-DEVELOPMENTAL ITEM ACQUISITION

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ABSTRACT

Non-developmental Item acquisition represents a viable approach to meet procurement needs of the Defense Department. The reduced acquisition cycle times and resultant cost savings of this acquisition strategy present significant potential benefits to DoD. One weapon system program that has successfully used such an NDI strategy is the U.S. Army's Fox Nuclear, Biological, and Chemical Reconnaissance System. This thesis examines the DoD acquisition process and how NDIs are used within the process. The thesis then examines the Fox Program and its NDI Acquisition strategy to determine what factors made the program successful. From this analysis, lessons-learned are identified that can be used by other acquisition managers and their staffs effectively to manage future NDI programs.

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I. INTRODUCTION

A. BACKGROUND

The rapid rise in the cost of weapon systems since World War II has led the armed services of most countries to seek the lowest cost alternative that will meet their defense requirements. The United States military has been one of the major suppliers through Foreign Military Sales of weapons and technology to meet their defense needs since the end of that war. The U.S. has striven to maintain a technological edge over its potential enemies while attempting to match numerical superiority.

The upward spiral of costs and budget reductions has increased the pressure on all branches of the Department of Defense (DoD) to hold down the costs of procuring new systems. DoD's acquisition of technologically superior weapon systems with the least amount of resources has become increasingly critical. One way to accomplish this acquisition is through the use of Non-developmental Items (NDI). An NDI acquisition offers three major benefits: operational needs quickly responded to, research and development costs are reduced or eliminated, and state-of-the-art technology used. One weapon system program that uses such an NDI acquisition strategy successfully is the US Army's Fox Nuclear, Biological, and Chemical (NBC) Reconnaissance System Program.

Two unique characteristics make the study of the Fox Program beneficial. The first characteristic is the success with which the Army has used an NDI acquisition strategy to acquire a major weapon system such as the Fox. This is of particular interest because of the problems the Army acquisition managers have had with past NDI acquisitions, such as the Roland, Sergeant York, and the Air Defense Anti-Tank System Programs.

The second characteristic of the Fox procurement is that it was procured from a foreign country (Germany), where it was designed and is currently being manufactured. This is significant considering the diverse plethora of laws, regulations, and DoD directives that force a program manager to become an expert in international laws and treaties to manage acquisition in the foreign marketplace effectively.

B. OBJECTIVE

The objective of this thesis is to examine the major factors that have made the implementation of the Fox Program's NDI acquisition strategy successful. From this examination, lessons-learned will be identified that will help other acquisition managers and their staffs to manage future similar programs effectively.

C. RESEARCH QUESTIONS

In pursuing the objective of this thesis, the following primary research question will be addressed: What are the major factors of the Fox Program's acquisition strategy that made the program a success, and what lessons can be learned from these factors that can be applied to other acquisition programs?

The subsidiary research questions that this thesis will address to aid in determining the answer to the primary question are the following:

1. How is NDI defined by DoD and the Army?
2. What are the benefits and challenges of using an NDI acquisition strategy?
3. What was the Fox Program's NDI acquisition strategy?
4. What made the Fox Program's acquisition strategy successful and what were the program's shortcomings?
5. What lessons-learned can be gained from the study of the Fox Program's NDI acquisition strategy?

D. SCOPE

This thesis is a case study of the Fox Reconnaissance System Acquisition Strategy. It covers only those aspects relating to the program's acquisition strategy and plan. Additionally, because this thesis focuses primarily on program management and not on technical aspects, it covers only a general description of the Fox. Classified aspects of the Fox will not be addressed.

E. LITERATURE REVIEW AND METHODOLOGY

Background information was obtained from reports, papers, periodicals, DoD documents, and U.S. Army manuals. These materials were obtained from a variety of sources including the Defense Technical Information Center, the Defense Logistics Studies Information Exchange, the Naval Postgraduate School Library, the Fox Program Office, and the United States Army Chemical School, Director of Combat Developments.

F. DEFINITIONS AND ACRONYMS

DoD and Army definitions and acronyms used in acquisition management and the Fox program are provided throughout the thesis where needed, and Appendix A provides a consolidated list of acronyms.

II. BACKGROUND

A. INTRODUCTION

This chapter provides an overview of the process used by the DoD to acquire major weapon systems. First, it will discuss the standard DoD acquisition process and acquisition strategies. Next, the chapter will define and discuss acquisition strategy in relation to its role in major weapon systems acquisition process. Finally, it will discuss each of the steps of the contracting process.

B. THE DEFENSE ACQUISITION PROCESS

The DoD acquires major weapon systems to provide operational military forces with hardware resources that will enable them to accomplish DoD objectives and policies. When operational requirements are determined to exceed existing capabilities, new programs are initiated. Acquiring these weapon systems is a complex and challenging process.

This large and complex DoD acquisition structure is guided by many external laws and regulations outlined in such documents as Office of Management and Budget (OMB) Circular A-109, Major System Acquisitions, and the Federal Acquisition Regulation (FAR). However, DoD has combined its acquisition guidelines into two primary documents. The first document is DoD Directive 5000.1, Defense Acquisition, and the second is DoD Instruction (DoDI) 5000.2, Defense Acquisition Management Policies and Procedures. The policies and guidelines expressed in these two documents form the basis for all subsequent procedural directives and instructions regulating DoD acquisition of major weapon systems.

DoD Directive 5000.1 provides broad basic policies covering defense acquisitions, while DoDI 5000.2 establishes more specific policies and procedures for managing these programs. To manage defense acquisition programs, DoDI 5000.2 outlines an acquisition process of five phases with five milestone reviews. The Defense Systems Management

College (DSMC) describes this acquisition process as

> The sequence of acquisition activities starting from the agency's reconciliation of its mission needs, with its capabilities, priorities and resources, and extending through the introduction of a system into operational use or the otherwise successful achievement of program objectives. [Ref. 1:pp. 4-5]

The acquisition process consists of two basic stages: development and production. These two stages are further broken down into several decision points (milestones) and acquisition phases, each of which will be discussed in this chapter. Comparatively, in terms of management and decision making, the second of these stages is quite simple, encompassing no more than the physical production of the system. The development stage includes the complexity of all the necessary steps taken before production begins.

The development stage encompasses three milestones and phases that start with identifying a threat or mission need, developing an acquisition strategy, and obtaining a budget to support that strategy. Once the funds are obtained from Congress, work begins to find technical approaches to meet the need. This is accomplished by awarding competitive contracts to industry. The Government prepares a Statement of Work (SOW) based on an approved acquisition strategy, which is then transformed into a Request for Proposal (RFP) or an Invitation for Bid (IFB) to attract interested contractors. The procurement process will be discussed further in this chapter. The Government evaluates contractor proposals, and it awards one or more contractors a contract. Under the terms of the contract(s), the contractor(s) deliver(s) the system to the Government, who in turn performs tests and evaluates. [Ref. 2:p. 22]

1. Acquisition Milestone Process

As the acquisition process evolves, it moves from a paper description of a concept to actual hardware that will ultimately go into production. Contractors whose concepts are not feasible are eliminated during the developmental phases until a production

contractor is ultimately chosen. There are four significant points at which key decisions are made during the acquisition process. [Ref. 2:p. 24]

a. Milestone 0 Decision

The first key decision (Concept Exploration and Definition) is made at the onset when the need has been identified in terms of the mission need. Once a system need has been identified, a Military Service must formally request program initiation at a Defense Acquisition Board (DAB) chaired by the Under Secretary of Defense for Acquisition and Technology (USD(A&T)). The Service must also have requested and obtained funding prior to the DAB review.

b. Concept Exploration/Definition Phase

Approval at Milestone 0 authorizes the start of the Concept Exploration/ Definition phase. An acquisition strategy is developed, and estimates and goals are defined in terms of cost, schedule, and performance expectations. Various concepts are presented by contractors, and contractors with the best concept(s) chosen to continue further development.

c. Milestone I Decision

A second decision point (Concept Demonstration and Validation) is then scheduled for a DAB review to authorize the start of another phase known as Concept Demonstration and Validation. Alternative system design concepts are carefully screened and the Service evaluates trade-offs on technical approaches. Concepts are demonstrated via advanced development models, simulation, or other means, and those with the greatest potential and technical feasibility are chosen to move into the next phase.

d. Concept Demonstration/Validation Phase

During the Demonstration and Validation phase, many administrative and technical concerns are addressed. Cost analysis, schedule estimates, and performance criteria must be at an acceptable level. Engineering and technical requirements must prove to be obtainable, and trade-offs must be reviewed before the next milestone review is scheduled.

e. Milestone II Decision

The third key decision point (Engineering and Manufacturing Development) grants approval to build full-scale weapon system models. The goal of this phase is to select a final prototype that is fully documented, tested, and producible.

f. Engineering and Manufacturing Development Phase

Competing systems and support subsystems are fully developed and tested, and a winner is chosen to go into production. The winning system must not only pass developmental and operational tests, but it must be evaluated as affordable before a production decision is made.

g. Milestone III Decision

The final decision point is to produce the weapon system. This decision is one of the most important, because it marks the end of Research and Development and defines the weapon system that is to meet the mission threat.

h. Production and Deployment Phase

Once the DAB approves the start of production at Milestone III, the system is deployed and must be supported. Milestone III not only approves production, but it ensures that logistics support has been well planned so that personnel are trained to operate and maintain the system once it is deployed.

i. Milestone IV Decisions

After several years, Milestone IV is scheduled to determine whether the system effectively meets the mission need, how the system should be improved to meet the threat, or whether it should be completely replaced. Figure 1 depicts the Department of Defense Acquisition Milestones and Phases.

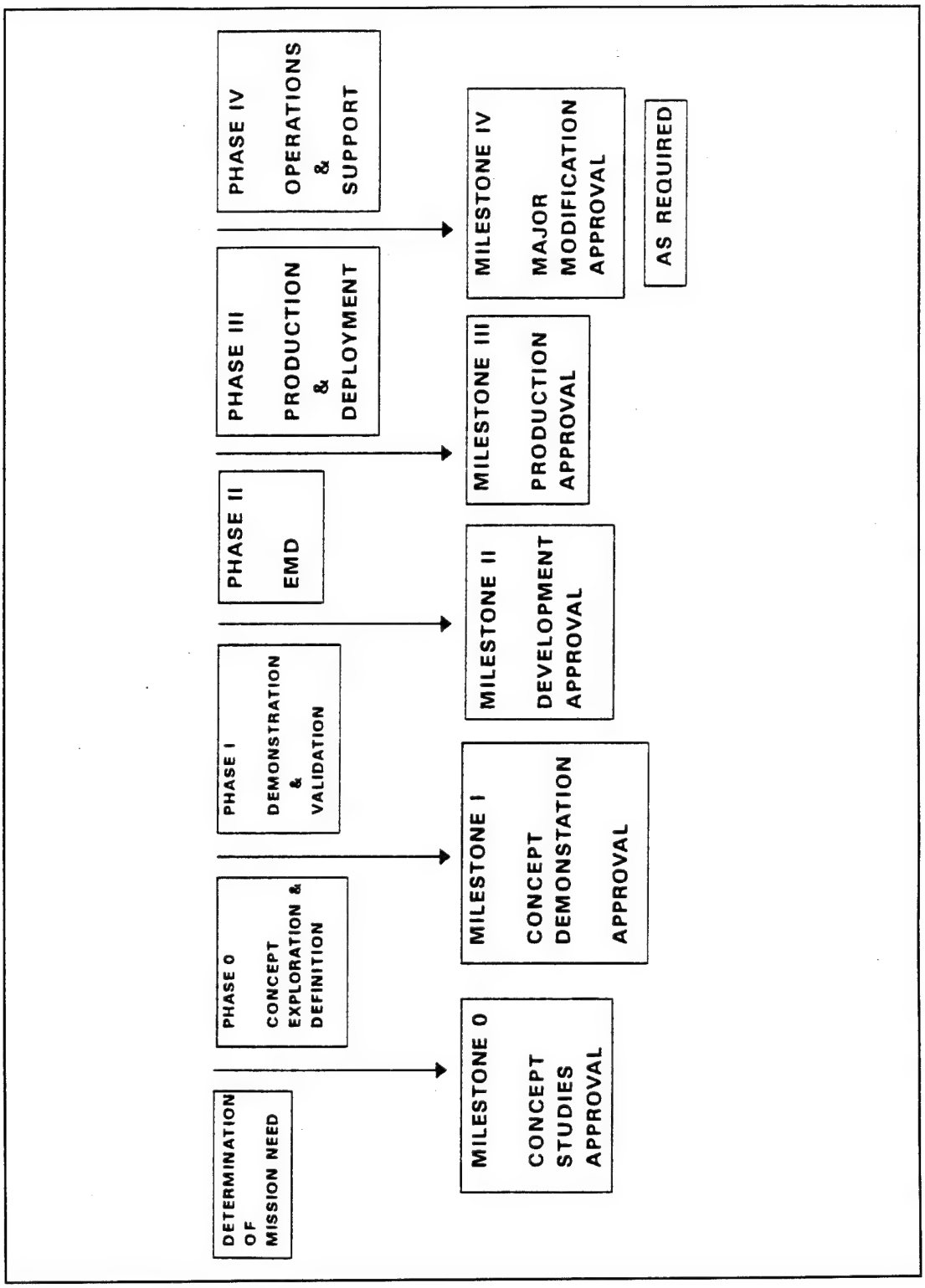


Figure 1. Acquisition Milestones and Phases

C. ACQUISITION STRATEGY

"Ideally, the acquisition strategy is structured at the outset of the program to provide an organized and consistent approach to meeting program objectives within known constraints." [Ref. 3:p. 3-1] The acquisition strategy is an overall plan to execute a program, and it should be developed within 90 days of a Milestone 0 approval. The acquisition strategy establishes the program objectives in writing, gives the program direction, and lays out assumptions and alternatives. [Ref. 3:p. 3-1]

1. Acquisition Strategy Principles

To meet the program objectives, the acquisition strategy must meet established principles: realism, stability, flexibility, resource balance, and controlled risk. [Ref. 4:pp. 3-9]

a. Realism

Realism in the acquisition strategy implies that the program has attainable goals and objectives. If the strategy is not realistic, the program will likely incur problems. The shortfalls may be in terms of schedules, costs, or even technical performance. Lack of realism in the acquisition strategy can easily foster program failure. The simplest way to accomplish realism is to research, study, and understand the requirements and their constraints.

b. Stability

The acquisition strategy is promoted by disallowing negative circumstances to influence the program goals. If stability is not maintained and a single aspect of the program begins to falter, the entire program can come under scrutiny, with all estimates and expectations becoming questionable. The stability characteristic is maintained in programs that are under complete control of their managers and in which no doubts about direction exist, programs that develop high-level support, and programs where lasting commitments have been made.

c. Flexibility

While stability is directed at restricting the change of program objectives, certain changes are inevitable. The acquisition strategy must demonstrate the flexibility to allow for unforeseeable changes and setbacks. Lack of flexibility in the acquisition strategy can result in instability in the program. In order to achieve flexibility, the program approach should evaluate the areas where change is likely and plan for possible changes.

d. Resource Balance

Resources are notably limited and must therefore be carefully managed. If all the requirements and goals within a program can receive an adequate portion of the dedicated money, time, and people, then resource balance can be realized. Setting priorities and recognizing risks are instrumental in preserving resource balance.

e. Controlled Risk

In the acquisition strategy sense, risk incorporates four key elements: the probability of failure within a program; the cause of the failure; the ultimate effect of the failure; and the uncertainty associated with each of these. Controlled risk is the most critical principle of the acquisition strategy. All efforts in terms of the four previous principles should be made to minimize risk. Successful risk analysis and assessment result in controlling and minimizing risk.

2. Acquisition Strategy Structure

The formal structure of the acquisition strategy involves three specific areas of interest: strategic, technical, and resource.

a. Strategic

The strategic concerns deal with the broad and comprehensive aspects of the acquisition strategy. Meeting the mission need, in terms of the national objectives and the security threat, is of concern at this level. The goals and objectives of the program and the prioritization of those are strategic issues, also. Time, money, and technical constraints, as well as other critical program issues, will be addressed at this point.

Finally, market influences, primarily industrial but also political, are of strategic concern.

b. Technical

In the technical area, the concerns range from design to deployment, with everything in between. Test and evaluation, reliability, supportability, and maintainability procedures are technical concerns. Performance trade-offs are at issue, and training is addressed. The matters of production and subsequent deployment are also of technical concern.

c. Resource

While the strategic and technical interests may deal broadly and abstractly with resources, this issue is crucial enough to stand alone. Resource concerns deal with managing time, money, personnel, and facilities for the acquisition strategy and the program.

D. CONTRACTING PROCESS

"System acquisition process means the sequence of acquisition activities starting from the agency's reconciliation of its mission needs, with its capabilities, priorities and resources, and extending through the introduction of a system into operational use or the otherwise successful achievement of program objectives." [Ref. 5:p. 3] Contracting is part of the acquisition process, but it is one of the most important, because it defines the terms and conditions under which contractors develop and produce weapon systems. During a typical acquisition, several contracts are awarded to help achieve the goals established for each acquisition phase. The contracting process normally incorporates the following sequence of activities:

- The Acquisition Plan
- Statement of Work
- Procurement Request
- Commerce Business Daily Synopsis
- Solicitation

- Technical Evaluation
- Cost Analysis
- Negotiations
- Contract Award
- Contract Administration
- Contract Modifications
- Completion or Termination

Each of these steps of the contracting process is discussed in some detail in the following sections.

1. The Acquisition Plan

While the acquisition strategy is a broad course of action developed to execute a program, it yields a decidedly precise Acquisition Plan that focuses on concrete specifics and lays out the contract strategy. Acquisition Plans are required for all programs with a total cost of all contracts greater than five million dollars. Acquisition for production or services when the total cost of all contracts for the program is estimated at 30 million dollars for all years, or 15 million dollars or more for any fiscal year. [Ref. 4:p. 8]

2. Statement of Work

The Statement of Work (SOW) prescribes the non-specification work to be performed by the contractor. Non-specification work is determined by stating the objectives, defining the scope and approach, providing background information, establishing a means for reporting and other tasks not covered in the technical documents. The SOW is the basis for source selection and the standard by which the contractor is judged once the contract is awarded.

3. Procurement Request

The procurement request (PR) is a funding document prepared by the program office. It also describes the services and quantities required under the terms of the contract.

4. Commerce Business Daily Synopsis

At this point, the Government normally places a synopsis in the *Commerce Business Daily* (CBD), a Department of Commerce publication, to attract contractor competition. It is a marketing technique required by the Competition in Contracting Act of 1984 whenever a competitive procurement is expected to exceed $25K. The purpose of synopsizing a potential sole source procurement is to attract possible competition. The CBD synopsis is a brief one-to two-paragraph description of a Federal Government requirement. Interested contractors may then contact buying activities and request a complete description of the Government's requirements. The Government provides that information in a solicitation package known as a Request for Proposals (RFP) or Invitation for Bids (IFB).

5. Solicitation

The two methods of contracting are sealed bid or negotiation. The procedure for the solicitation process differs depending on the complexity of the procurement and the cost information available to the Government.

a. Sealed Bid

The sealed bid method is used primarily for recurring items when there is more than one competitor and discussion with the vendors is not necessary. The Government issues an IFB and allows enough time for prospective firms to prepare and submit their sealed bids. At a specified date and time, the Government opens the bids and awards the contract to the lowest qualified bidder. This award is based on price-related factors alone. [Ref. 6:p. 233]

b. Negotiation

The negotiation method is used when discussion, oral or written, is desired and necessary. Therefore, it is the most common method used for major systems acquisition. For this method, the Government issues a Request for Proposals (RFP) solicitation describing the requirement, including source selection criteria. Interested and qualified firms then submit their proposals for review and selection. [Ref. 6:p. 232]

6. Technical Evaluation

In the case of sealed bids, little, if any, technical evaluation is required. All qualified bidders must meet the minimum technical requirements. However, a technical evaluation will be conducted when a negotiation is required. Criteria may include such factors as design approach, system engineering experience, management ability, and technical capability of the vendor.

7. Cost/Price Analysis

Cost analysis is accomplished on each proposal. Cost analysis is a detailed review of materiel, labor, and overhead costs and is used as a basis for negotiating with contractors. Price analysis is simply looking at the bottom line without a thorough review of how the contractor reached that bottom line. It is used when sealed bidding is the procurement method chosen. Price analysis techniques include comparing contractor proposal prices with each other, and comparing them to earlier similar proposals and catalog prices.

8. Negotiations

Negotiation involves all of the terms and conditions of a contract including cost. While both the Government and the potential contractor strive to optimize their own position during the negotiations, they also attempt to obtain a mutually acceptable agreement on requirements for performance, schedule, and cost.

9. Contract Award

a. Selection

Under the sealed bid method of contracting, a responsible low bid usually results in a contract award. If the contract is negotiated, the selection is based on a formal process for major weapon systems. The Secretary of a Military Service normally appoints a Source Selection Authority (SSA), a Source Selection Advisory Council (SSAC) and a Source Selection Evaluation Board (SSEB) to accomplish this task. The SSEB evaluates the technical and cost merits of each proposal (technical evaluation and negotiations are addressed in steps 6 and 8 above) and submits a report to the SSAC, who

assigns predetermined weights and recommends a selection to the SSA. "The SSA then selects the winning contractor or contractors based on (1) comparative evaluations of proposals, (2) costs, (3) risk assessment, (4) past performance, (5) contractual considerations, and (6) surveys of contractor capabilities." [Ref. 2:p. 30]

b. Contract Types

At the most basic level, there are two types of contracts: fixed-price and cost-reimbursement. The amount of risk the Government calculates into the program determines which type of contract is used. These basic types are further defined and categorized.

(1) Fixed-Price. A fixed-price contract entails the delivery of the items by the contractor for the specified price or less. This may hold risk for the contractor but not necessarily for the government. Fixed-price contracts include the following:

- Firm-fixed-price
- Fixed-price with economic adjustment
- Fixed-price incentive firm target
- Fixed-price level of effort

The above fixed-price contracts are simply different versions designed to give contractors an incentive to establish and maintain cost ceiling. If they meet or beat these ceilings, additional profit may be awarded based on a predetermined formula in the contract.

(2) Cost-Reimbursement. Cost-reimbursement, or cost-plus, contracts require the contractor to provide the product or service for an estimated amount, plus a fee. The basis for payment is contingent on the allowability of cost applied to the task at hand. If the Government accepts the costs as allowable and allocable, the contractor is paid along with some profit (fee). Based on this definition, the Government assumes all financial risk, but this assumption of risk is necessary when systems are being developed for the first time with functional specifications, unknown designs, and technical

risks that are difficult to price out in advance of contract award. Types of cost-plus contracts include the following:

- Cost plus fixed fee
- Cost plus incentive fee
- Cost plus award fee

10. Contract Administration

The Government performs contract administration and monitoring both technically and administratively. The monitoring involves written reports, formal and informal meetings, and ongoing observation of the contractor's progress. Constant and persistent monitoring may preclude long-term contractor deficiencies.

11. Contract Modifications

Modifications to a contract are often required. Unfortunately, circumstances change, and the need to modify may come on the part of the Government or the contractor, depending on changes in requirements or changes in deliverables. In most cases, modifications require renegotiation to establish a fair and reasonable price for the task the contractor is to accomplish.

12. Completion or Termination

Finally, a contract will end in one of two ways: completion or termination. Completion means successful delivery of the finished product. Termination can be for convenience of the Government, because the item/s is/are no longer required, or because the contractor defaulted on some term or condition within the contract.

III. NON-DEVELOPMENTAL ITEM ACQUISITION

A. INTRODUCTION

The United States Army requires both people and equipment to perform its assigned mission. Equipment procured ranges from individual items to sophisticated missile systems. NDI procurement continues to be a major topic of interest to the Army, industry, and Congress.

In general, the Army procures two types of items - developmental and non-developmental. In the past, most systems have been fielded through the lengthy developmental process, but the Army can no longer afford the time or resources this involves. Consequently, NDI procurement is the preferred Army acquisition alternative and is one of the better methods of acquiring equipment in an orderly, expeditious manner under the Army Streamlined Acquisition Process. [Ref. 7:p. 22] NDI systems require little or no developmental effort by the Army because they are available "off-the-shelf" from a variety of sources. This chapter reviews the NDI process and its advantages through examples of major non-developmental materiel systems purchased by the Army for use by units. It also reviews challenges to the process that threaten its survival.

B. BACKGROUND

NDI systems require little or no development effort. NDIs can include materiel developed and in use by other U.S. Military Services or Government agencies, materiel developed and in use by other countries, and commercially available materiel. The acquisition process for an NDI is not a separate process, but a tailoring of events within the materiel acquisition process, and it should be one of the first alternatives considered for solution to a materiel need. [Ref. 8:p. 27] General categories of NDI are:

1. Category A

This category includes those off-the-shelf items (commercial, foreign, other Services) used by the Army in the same manner and environment for which they were designed. "No development or modification of hardware or operational software is required." [Ref. 8:p. 27]

2. Category B

This category includes those off-the-shelf items (commercial, foreign, other Services) designed for specific environments but used by the Army in different environments. "These items require modification to hardware or operational software." [Ref. 8:p. 27]

There is also another approach to NDI that emphasizes the integration of existing componentry and essential engineering efforts to accomplish systems integration. This strategy requires a dedicated Research and Development (R&D) effort to allow for system engineering of existing components, for software modification/development, and to ensure the total system meets requirements. [Ref. 8:p. 27] This approach is used when there is no end item available, but components have been identified by the materiel developer, allowing integration to meet the requirement. This process is commonly referred to as a third level of effort. [Ref. 16:p. 2]

C. REQUIREMENTS DETERMINATION

An NDI materiel system is procured to correct an existing deficiency surfaced during the Concept-Based Requirement System (CBRS) and Mission Area Analysis (MAA) process. However, because of the costs and time involved in procuring hardware systems, four other areas are examined before new hardware solutions are adopted. These include: 1) changes to doctrine, 2) changes to unit and individual training, 3) changes to or new Table of Organization and Equipment (TOE) and/or Table of Distribution and Allowances (TDA), and 4) modifications to fielded hardware. When a new hardware system is ultimately identified as the best solution for the deficiency, the acquisition process begins with the necessary requirement documents. During requirement documents

formulation, systems are identified as NDI candidates. The two most significant documents in this process are the Operational and Organizational (O&O) Plan and the Operational Requirements Document (ORD) or, if the document will be used by more than one Service, a Joint Service Operational Requirements Document. [Ref. 16:p. 3]

The O&O Plan initiates the materiel acquisition process and outlines the effects of employing the new hardware system in units. It explains how the system will be used, where it will be employed on the battlefield, and how it will interface with other systems. Although the combat developer is responsible for the development of the O&O Plan, the materiel developer is also actively involved because he or she uses the O&O Plan to conduct the market survey. [Ref. 16:p. 4]

Market survey results determine if there is either an NDI product or non-developmental assemblies or components that can be integrated that satisfy the requirement. The Government uses investigations conducted under the approved O&O Plan to verify the applicability of technology and man/machine interface. These initial investigations are then used to define and identify the essential operational characteristics defined in the ORD. [Ref. 16:p. 4]

The ORD is the formal requirement document that commits the Army to system development and acquisition. It is prepared by the combat developer, in coordination with Headquarters, Department of the Army; the materiel developer; training developer; rationalization, standardization, and interoperability manager; logistician; manpower and personnel integration (MANPRINT) planner; tester; evaluator; and interested major command. This document provides the operational performance characteristics, usually in bands of performance, of the desired system. Two annexes to the ORD address assumptions, methodology, and cost effectiveness of the system. These annexes are the Cost and Operational Effectiveness Analysis and the Basis of Issue Plan, respectively. [Ref. 16:p. 5]

During ORD development, requirements are scrutinized and trade-offs are determined. This requirement trade-off process is critical to avoid including unproven capabilities or characteristics in the ORD and to keep the system in the NDI category.

The trade-off process has two phases: 1) the materiel developer performs a Trade-off Determination (TOD). The materiel developer provides this information to the combat developer along with information on materiel options available to eliminate a battlefield deficiency, 2) the combat developer then performs a Trade-off Analysis based on the thrust, doctrine, organizational concepts, and the materiel possibilities identified in the TOD. Trade-offs include the relaxation of system specifications whenever possible and a review of the environments where the system must perform. Ideally, everyone should be equipped with the same system. However, it may be more cost effective to modify a system that will be deployed to extreme conditions, for example, the cold arctic or the arid desert. Both the combat and materiel developer must work closely to formulate system requirements and to keep the program in the NDI realm. [Ref. 16:p. 5]

The Army is committed to NDI as an acquisition alternative; therefore, a written justification must accompany the acquisition strategy when NDI is not employed. The justification must address the considerations given to NDI to ensure that NDI avenues have been completely investigated.

The next section will look specifically at NDI history, advantages, and some systems that have been successfully fielded as NDI systems.

D. ADVANTAGES OF NDI

In 1976, The Office of Federal Procurement Policy (OFPP), within the Office of Management and Budget, directed that "Agencies shall purchase commercial products... whenever such products... adequately satisfy government needs." [Ref. 9:p. 36] OFPP saw no reason why Government agencies should not be able to use commercial products in the same manner as other institutions and industrial consumers. A policy was designed to take advantage of innovations and efficiencies of the common marketplace and avoid the development of duplicative Government contracts. In other words, this policy gave Uncle Sam more "bang for the buck." There are a number of advantages to the NDI process: shorter acquisition cycle, lower cost, production base maintenance, and equipment commonality.

1. Shorter Acquisition Cycle

The NDI acquisition life-cycle model takes two-and-one-half years versus the classical research and development cycle that requires 8 to 16 years. [Ref. 10:p. 2] NDI strategy saves a considerable amount of time in the overall acquisition cycle of a system or equipment, with the real difference in the middle two phases.

The standard acquisition life cycle has five phases:

- The concept exploration and definition phase, where the Government explores potential ideas, concepts, and solutions so a proper alternative for hardware development can be determined.
- The demonstration and validation phase, where the Government reviews competing systems to determine which contractor's system best meets the requirement and where the decision is made on whether to continue.
- The engineering and manufacturing development phase, where the contractor systems are designed, fabricated, tested and evaluated.
- The production and deployment phase.
- The operations and support phase.

In NDI, the demonstration and validation, and engineering and manufacturing development phases, which can range from four to five years, are combined into one phase. This phase is one to two years long, and is often referred to as the acquisition documentation phase. [Ref. 10:p. 2] During this phase, the Request for Proposals is prepared and proposals are received and evaluated.

Once an NDI acquisition strategy is selected, phase two of the standard acquisition life cycle can be skipped or compressed. This is because R&D engineering, design, integration, integrated logistics support, and test or evaluation effort may not be needed. The NDI strategy also allows use of previous test and performance data from commercial manufacturers, users, and other Services, agencies, or countries to prove both product acceptability, suitability, and military operational effectiveness and suitability. To capture this benefit, independent evaluators must become involved early, participate in the program, provide independent evaluation reports and ensure that planned test and evaluation efforts satisfy the testing requirements. [Ref. 16:p. 9]

2. Lower Cost

An NDI system costs less because there are limited R&D costs, commercial specifications available, and competition in the marketplace. An example of this is the Mobile Subscriber Equipment (MSE), a tactical communications system capable of passing data, facsimile, and voice traffic throughout the Division and Corps area of operations. Estimates show that MSE, a $4.3 billion acquisition program, saved over $500 million in R&D costs. The costs were saved because these items are generally in production and are commercially available. Commercial specifications save the Army costly development of test and historical data, technical publications, drawings, manufacturer's part information, quality, safety, and reliability data. The requirements trade-off process is also critical to keep a system's cost down. [Ref. 16:p. 9]

NDI systems cost less because the preferred contract method is to award the contract to the lowest responsive bidder, unless otherwise justified. This does not imply that lowest price is always the qualifier when contracts are awarded, or that this acquisition decision is not in the best interest of the taxpayers. If two contractors meet the minimum stated requirement, however, and one is envisioned to have a better product by either the materiel or combat developer, by regulation, the lower bidder will still be awarded the contract. [Ref. 16:p. 9]

Another reason for NDI is that the Competition in Contracting Act requires that competition be maximized. Only in unique circumstances (for example, buying a limited number of a fielded system, or when there are overriding readiness and/or logistics considerations), can a noncompetitive selection be justified. Competition is instrumental in getting a system's cost down. An example is the Army's five-year contract on the 5-Ton Truck. This vehicle's price was reduced by $10,000 per vehicle, attributed to competition among three vendors. [Ref. 10:p. 6]

3. Maintains Production Base

The Army's industrial mobilization base consists of Government-owned facilities and equipment and the supporting private sector industrial base. NDI procurement broadens this private sector base and increases the number of defense contractors.

Congress recognizes that "War is no longer simply a battle between armed forces in the field...it is a struggle in which each side strives to bring to bear against the enemy the coordinated power of every individual and every materiel resource at its command. The conflict extends from the soldier in the front line to the citizen in the remotest hamlet in the rear." [Ref. 11:p. 7] When the peacetime defense industrial base is healthy, the rapid expansion for emergencies and the mobilization for a major war is significantly enhanced. [Ref. 12:p. 99] This fact has been learned and relearned by the U.S. many times. In World Wars I and II, and in both the Korean and Vietnam conflicts, expenditures far exceeded pre-war estimates, and reserves of materiels were quickly exhausted. Inadequate plans for military procurement and industrial mobilization caused uncoordinated Government purchasing, inequitable distribution of industrial land and resources, and inefficient use of transport systems. This produced delays, waste, violent price disturbances, and unequal burdensharing. NDI procurements broaden the mobilization base with limited Government investment. NDI encourages private investments in mobilization facilities and their maintenance because NDI accepts the reality of the profit motive. NDI contractors formulate their costs to include profits. (As previously stated, the lowest bidder is usually awarded the contract.) Also, NDI system requirements are often refined to keep the system in the commercial realm, but this minor decrease in capability is acceptable as a trade-off for production during mobilization. [Ref. 16:p. 11]

4. Allows for Equipment Commonality

By procuring commercial systems in use by another Service or nation, equipment commonality is enhanced. This is especially critical because it reduces the logistics burden. This commonality also allows personnel from one Service/nation to operate the system of another. The advantages offered are currently being pursued in Host National Support Agreements and Interoperability Agreements. A system currently the subject of an Interoperability Agreement is the Palletized Loading System (PLS). PLS is a 16.5-ton truck that will be fielded in U.S. Army units. This concept is designed around an integral self-load/unload capability enabling the driver to load or unload the entire cargo bed from within the cab in a matter of minutes. This capability will also be fielded in the armies

of the Federal Republic of Germany and in the United Kingdom. To ensure compatibility/commonality, three nations are working together in the design of improvements. [Ref. 16:p. 12]

The Army has had several major programs procured as NDI systems. The following are examples of successes:

Commercial Utility Cargo Vehicle (CUCV): The CUCV is a tactical wheeled vehicle family that includes 3/4-Ton and 1 1/4-Ton vehicles. The CUCV fills a requirement for a vehicle to operate in areas where the environment is not severe and a more expensive high mobility vehicle is not required. The CUCV is a basic General Motors Blazer with minor military modifications, e.g., a fording capability, cold weather kits for temperatures of 25 to 50 degrees below zero, camouflage paint and rings for sealift. Even with these modifications, the CUCV was successfully fielded in three years. The CUCV was purchased for an on-road capability and replaced vehicles with an off-road capability. This caused user problems. But once educated, the user was satisfied, and even found additional areas where a commercial vehicle was acceptable, e.g., as signal shelter carriers. [Ref. 16:p. 12]

Lightweight Collapsible Pillow Tank (LCPT): The LCPT is a 170-gallon pillow tank procured as a Category A NDI because of the wide commercial use of these tanks. The LCPT provides potable water transport and distribution capabilities to the Light Divisions. The requirement for the LCPT surfaced during the evaluation of the maneuver division of the light forces in June 1985. The LCPT was designated Category A NDI during the preparation of the O&O plan and subsequent market surveys. The fielding of these tanks took three years. During these three years, an O&O plan and Required Operational Capability Document (ROC) were formulated and approved; the item type classified; procurement funds budgeted; training and testing requirements assessed; and safety, health, and logistics requirements formulated. Five firms were found technically qualified to meet the Army's minimum requirements, and a contract was awarded to the lowest-priced technically acceptable bidder. [Ref. 16:p. 13]

Mobile Subscriber Equipment (MSE): MSE is a complicated system that totally

integrates all communications system functions. Transmission equipment, switching equipment, communications security, system control, vehicles, and generators are all part of the MSE system being bought from a single contractor. The acquisition strategy for MSE is very unconventional. The Army provided the bidders only a general performance requirement, not detailed specifications or drawings. Contractors were then free to state how their proposed system met the requirement. Although the MSE program does comply with the statutes and conform to law, acquisition regulations were waived, as necessary, to encourage the use of commercial practices. The MSE contract was awarded in 1987, and testing began in 1988, with fielding completed in 1993. [Ref. 16:p. 14]

E. CHALLENGES TO NDI

Although an NDI procurement strategy gets equipment into the hands of troops more quickly and costs less than traditional developmental systems, several challenges threaten its survival. These challenges include:

1. User Requirements

> ...we're starting to realize that if we want to field something before it becomes obsolete, then we may have to look at what's already out there and remain flexible. We can't expect the world and get it off the street. We might not have technologically advanced weapons, with all the bells and whistles, but at least we'd have the things we want and need, and probably at a better price. [Ref. 13:p. 27]

This approach challenges user requirements. Additional requirements must not be allowed to creep into the system that did not exist when the requirement was recognized and approved. The user should recognize that although there are capabilities that would be nice to have, adding additional bells and whistles defeats the purpose of an NDI procurement. It has been estimated that adding an additional 10 percent of capability adds one-third to the cost and two-thirds to the problems in our system. [Ref. 14:p. 56] Requirement documents must be examined and unrealistic requirements eliminated, especially with added Congressional interest in system quality. If a system fails prototype testing, there are two options for the Army. One is to relax the original requirement, and

the other is to reject the system. The Army can save time and embarrassment if original requirements are realistically developed, using proven and available technologies. [Ref. 16:p. 17]

2. The "Not Invented Here" Syndrome

This problem occurs when an NDI product is adopted, but then the Army proceeds to reinvent or redesign it. These modifications can be minor or major and are best described by using the Roland as an example. The Roland was fielded by NATO allies and was intended to fill the Army's crucial need for an air defense system without the R&D costs and developmental lag of a new system. In 1974, the Army bought 184 Roland fire units and awarded a modification contract to two developers. Seven years and $1.1 billion later, the Army cancelled the program. From the outset, the program was beset by many developmental difficulties. Having adopted the European version of an air defense system, the Army proceeded to reinvent it, and in doing so, the Army redesigned the Roland right out of existence. Developmental difficulties produced delays that eliminated the original rationale for adopting an existing foreign system, namely saving time. [Ref. 13:p. 28]

3. Buy American

One form of NDI acquisition is the procurement of off-the-shelf equipment from foreign sources, but there is little support in Congress to allow the U.S. Army to buy equipment not manufactured in the U.S. This is both for fiscal considerations and to sustain the technology and manufacturing leadership essential to this nation's security. The Buy American Act (41 U.S.C. 10a-d) provides that the Government give preference to domestic source-end products. This is true for all products except those to be used outside the U.S., those not available in the U.S., those for which the U.S. Government determines the domestic cost is unreasonable, or those for which the country producing a product has signed a reciprocal Memorandum of Understanding with the U.S. These requirements are meant to alleviate the impact of DoD expenditures on the U.S. balance of international payments. Remembering that the lowest bidder is awarded the contract in almost all cases, the Buy American Act, which adds a factor of 50 percent to the unit

cost, often precludes the procurement of off-the-shelf foreign items. [Ref. 16:p. 18]

4. Funding Instability

As the defense budget declines, contractors are becoming more reluctant to enter the defense business. Because NDI systems require little or no R&D effort and are considered available on the commercial market, cutting NDI programs is much easier. However, as the Total Obligation Authority shrinks, the Army must weigh modernization items against readiness efforts. Once the Army commits itself to a commercial item, it must also commit to its funding both for the current and out-years. According to DoD studies, out-year funding is often for replacements because the service life of a commercial item is shorter than that of a militarized item. A contractor's initial bid is often a buy-in. Contractors often base their profit margin on both the initial and the follow-on contract. Fewer contractors will become involved in defense business if funding fluctuates greatly from year to year. [Ref. 16:p. 19]

5. Testing

Congress is interested in seeing soldiers get quality equipment. Their guidance is that "the engineering excellence of...new programs be evaluated" [Ref. 15:p. E188], and they have given added authority to the Director, Operational Testing and Evaluation. This added authority and emphasis on testing will increase the administrative burden on the materiel developer as he or she tries to bypass/shorten testing on an already proven NDI system. [Ref. 16:p. 19]

The following are examples of systems that have been delayed or affected by the challenges previously discussed:

6,000 lb Rough Terrain Forklift (RTFL): This program shows the danger of both requirements creep and what happens when the combat and materiel developers do not work together to formulate requirements. In 1983, the combat developer stated a need for a forklift to unload ammunition from containers, but did not state that a shooting boom capability was required. This capability was added after visits by industry representatives, who stated that the technology was available on the commercial market. Because this technology could not be validated by the materiel developer during the

market survey, however, the Under Secretary of the Army directed prototype testing. This program shows how a system can get off track if the materiel and combat developers do not work closely to ensure requirements that capture NDI benefits are adopted. This program had so many problems that procurement funds programmed in 1984, 1985, and 1987 could not be obligated and were lost. These were funds that could have been utilized by the Army in other areas. With the declining budget, the Army cannot afford another 6,000 lb RTFL-type situation. [Ref. 16:p. 20]

Palletized Loading System: This program is an example of the "Buy American Act" and "Not-Invented-Here" syndrome. As stated earlier, PLS is a 16.5-ton vehicle with an integral self-load/unload design. This concept was developed by Great Britain which wanted to share its technology and doctrine with the U.S. to capitalize both on the economic benefits and on interoperability with an ally. Under the "Buy American Act" and with the "Not-Invented-Here" syndrome, however, the Army opted to compete this system only among American manufacturers. This means tests must be performed that may not have been required if the British system had been purchased - tests that will add over a year to the process. Realistically, it is easy to understand why Congress would be reluctant to allow the Army to award a five-year procurement contract to an overseas source, especially with the number of U.S. automobile manufacturers, the weak domestic market, and the requirement that the U.S. production base be maintained. It must be recognized, however, that technological break-throughs are not realized from solely one country and we need to capture the best of everyone's technology with NDI even if an English vehicle is fielded in the U.S. Army. [Ref. 16:p. 21]

Commercial Utility Cargo Vehicle (CUCV): The CUCV replacement vehicle was a victim of funding instability. The CUCV was originally procured through a five-year contract that ran from 1983 to 1987. Because the CUCV service life was set at five years, procurement of replacement vehicles was to begin in 1989. However, because of budgeting decrements, the 1989 CUCV rebuy program was slipped into 1992 and the service life of the vehicle was extended to seven years. What message has this sent to defense contractors interested in the CUCV? Will they start investigating other areas,

possibly non-defense related, where they can sell their products? What readiness and maintenance cost will the Army incur by maintaining old vehicles until new ones can be fielded? These are questions that Army leadership must address as they make those hard budget decisions. [Ref. 16:p. 21]

F. CONCLUSION

NDI is here to stay, but efforts must be made to deal with those challenges that cause some to question the process. The most critical of these challenges is the requirements determination process. The user and materiel developer must identify system requirements and address requirements trade-offs early. It is much easier to justify original requirements than to try to explain why requirements can be relaxed.

The Army's MSE contract "sent a clear signal of what a number of insiders characterize as a fundamental shift toward the acquisition of existing Non-developmental Items." [Ref. 13:p. 17] We must learn from this system. As we gain additional knowledge, we will continue to reap the savings, both in time and money, offered by NDI acquisitions. NDI is not the answer for all acquisition programs, but each NDI item procured frees R&D dollars for areas where they are truly needed. In this time of budget decline, the Army must realize that NDI offers systems "we want and need, and probably at a better price." [Ref. 13:p. 19]

Finally, NDI may offer a partial solution to America's cry for more burdensharing from our allies. If we could convince our allies to provide equipment to U.S. units, as well as other allied units, at a reduced cost, then the U.S. could reduce or get more for its defense dollar, and all could gain from the commonality this would provide. [Ref. 16:p. 23]

IV. THE FOX PROGRAM

A. DESCRIPTION OF THE FOX

The XM93 Fox Nuclear, Biological, and Chemical Reconnaissance System (NBCRS), produced by General Dynamics Land Systems and Thyssen Henschel, is a dedicated system of NBC detection, warning, and sampling equipment integrated into a high speed, high mobility, armored carrier capable of performing NBC reconnaissance on primary, secondary, or cross-country routes throughout the battlefield. [Ref. 17:p. 1]

The Fox finds and marks chemical and nuclear contamination on the battlefield. It provides warnings to follow-on forces through a secure communications system. The crew is protected by an on-board overpressure system. The XM93 is a Nondevelopmental Item (NDI) interim system, fielded to meet urgent requirements. [Ref. 17:p. 1]

The Fox has the capability to detect chemical contamination in its immediate environment through point detection, and at a distance through the use of a stand-off detector. The Fox automatically integrates contamination information from sensors with input from on-board navigation and meteorological systems, and it autonomously transmits digital NBC warning messages through the Maneuver Control System. [Ref. 17:p. 1]

The Fox detects, identifies, quantifies, and marks NBC contamination and is fast enough to keep pace with tactical forces. The system accommodates a three-man crew and provides NBC ground reconnaissance to support tactical operations. Two systems, working as a team, will precede the movement of troops and materiel to locate and mark contaminated areas. [Ref. 17:p. 1]

B. ACQUISITION HISTORY OF THE FOX

The Mission Area Analysis (MAA) for Combat Support identified a need for a reconnaissance system that would provide commanders with timely and accurate NBC information. Current systems were rudimentary, labor-intensive, and slow, requiring the crew to dismount to conduct NBC reconnaissance. The data and sample collection operation was such that a serious lag occurred between the collection of data, its analysis, and the transmission of information to the ultimate users. Because the threat of NBC contamination is high, the Army critically needed a fully integrated and timely NBC reconnaissance system.

From 1981 to 1984, various detection methods/devices were investigated via contract programs for possible use as a chemical sensor in reconnaissance applications. Both tandem mass spectrometry and ion mobility spectroscopy were shown to be feasible methods, as both displayed good potential for achieving the desired levels of response times, specificity, and sensitivity. [Ref. 19]

From 1985 to 1988, the XM87 design evolved out of the Concept Evaluation Program (CEP). The CEP provided the mechanism to evaluate concepts in the real-world environment. The results of the CEP were incorporated into a development contract. Nine subsystems were integrated into engineering and test models. In February 1988, a Department of the Army-level decision directed termination of the XM87 Program and initiation of acquisition of the Fox. In July 1988, Congressional direction required a full and open competition for the NBCRS contract. An NDI competitive "shoot-off" between contractors was conducted instead of purchasing the Fox. The winner of the "shoot-off" was the production team of General Dynamics Land Systems (GDLS) and the German firm of Thyssen Henschel. [Ref. 19] Figure 2 illustrates the characteristics and significant features of the Fox.

In March 1990, a firm-fixed price (FFP) contract was awarded for the Interim System Production (ISP) Phase. This contract provided for 48 interim XM93 systems identical to the evaluated "shoot-off" system selected. The XM93 was type classified-

FOX . . . *NBC RECONNAISSANCE SYSTEM*

FOX CHARACTERISTICS

Weight	
Combat Loaded	19.2 Tons
w/o Crew & Ammo	18.3 Tons
Length	23.9 Feet
Height	8.4 Feet
Width	9.8 Feet
Ground Clearance	17.0 Inches
Running Gear	
Engine	V8 Diesel . . . . 320 HP
Transmission	6 Speed . . . . Automatic
Wheels Driven	6X6
Wheels Steered	4

SIGNIFICANT FEATURES

- Operating in the West German Army
- Mobile Mass Spectrometer
- Two Surface Sampler Wheels
- INTEGRATED
  - Nuclear Detection
  - Chemical Detection
  - Position/Location System
  - Area Marking System

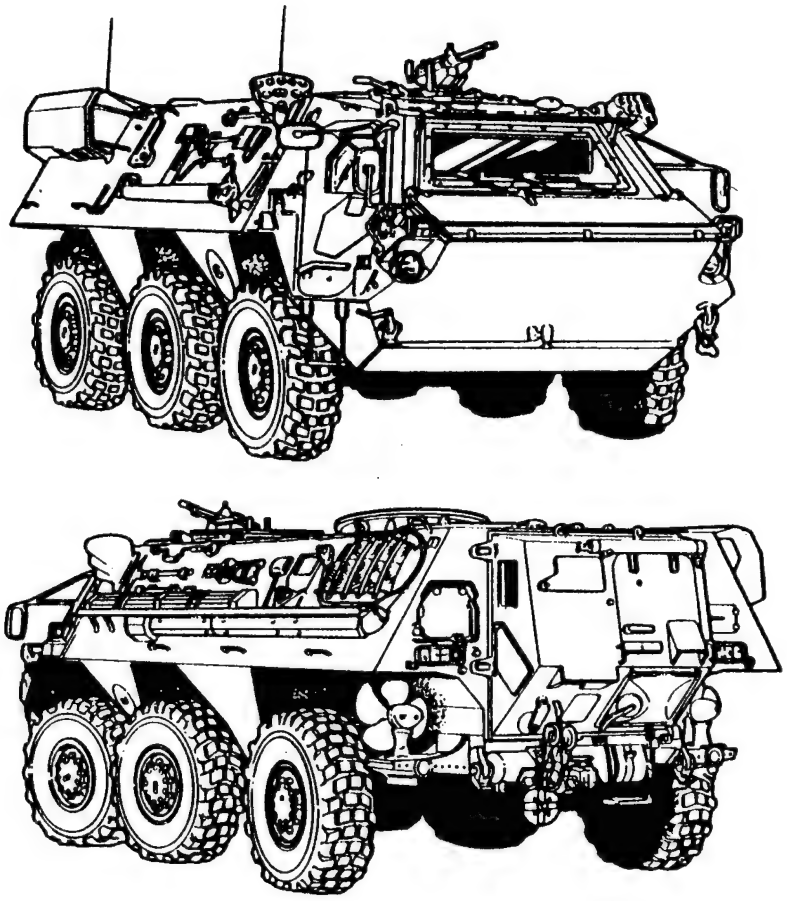


Figure 2. Characteristics and Features of the FOX

limited procurement urgent (TC-LPU) by the Army. [Ref. 20:p. 2]

A cost-plus-incentive-fee contract was awarded in March 1990 to design, fabricate, and test the System Improvement Program (SIP) XM93E1. The XM93E1 Program would satisfy all Required Operational Capability (ROC) requirements except identified pre-planned product improvements (P^3I). It would also reduce the crew size from four to three, and develop organic maintenance capability. The engineering effort was managed through preliminary and critical design reviews for both hardware and software. Ten XM93E1 prototypes were built during this phase. Milestone III and type classification-standard (TC-STD) are scheduled for 2QFY95. [Ref. 20:p. 2]

A Full Rate Production Phase was intended to produce the XM93E1 for worldwide fielding. This phase was reduced to a Block 1 Modification to retrofit existing systems to the XM93E1. The solicitation for the Block 1 Modification is planned for FY95, with an award to be made in January 1996. The Block 1 Modification program will include verification and publication of technical manuals, engineering changes to address deficiencies identified during earlier testing, and final production engineering for the Block 1 Modification installation. [Ref. 20:p. 2]

The ROC identifies P^3Is that are not required for the SIP XM93E1. The P^3I will be introduced through subsequent block modifications as technology permits. [Ref. 20:p. 2]

The Operations and Support Phase will begin with a transition of program management responsibilities to the Armament and Chemical Acquisition and Logistics Activity in Rock Island, IL. This transition will occur approximately six months after the first unit equipped (FUE) date. The FUE for the XM93E1 is expected in 2QFY98. [Ref. 20:p. 2]

C. FOX ACQUISITION STRATEGY

The Fox acquisition strategy was prepared in the format required by Army Regulation 70-1. It identified several major elements that are critical to the overall management of the program. Each of these elements is discussed below:

1. Program Structure

The program structure for the Fox Program called for a prime contractor with total system integration responsibility. The Army implemented this program structure by the use of an NDI strategy utilizing contractor-provided systems for an evaluation and selection of a single NDI system for follow-on improvement and production. The Program Manager (PM) would manage the program with technical support from various Army Materiel Commands (AMC). This program structure is the only alternative that met the Congressionally mandated schedule for execution of an NDI program that provided early fielding of an NBCRS. [Ref. 17:p. 1]

2. Contracting Strategy

The Fox acquisition strategy called for a contracting strategy that made the maximum use of competition throughout the entire process. A Request for Proposals (RFP) solicited the following:

1. Proposed NDI systems for use by the Government in a "shoot-off" test and evaluation.

2. Conduct of a systems improvement program to satisfy all requirements contained in the ROC except P^3I.

3. Production of 48 interim systems for fielding in Europe.

4. Conduct of full-scale production options for up to five years at the completion of the system improvement phase. [Ref. 17:p. 2]

The successful offeror will be awarded a multi-year contract for production of the 48 systems for an interim fielding capability in parallel with the execution of a systems improvement phase effort to meet all the requirements in the ROC. [Ref. 17:p. 2]

3. Tailoring the Acquisition Process

This section of the acquisition strategy contained an explanation of how the acquisition process would be tailored for the Fox Program. The strategy stated that the tailored-acquisition strategy would consist of the following phases: (1) "shoot-off"

evaluation of NDI candidates, (2) interim system production of 48 NDI systems for fielding in Europe, (3) system improvement to satisfy all NBCRS ROC requirements, without P^3I, and (4) full-scale production of NBCRS systems to satisfy ROC requirements without P^3I. [Ref. 17:p. 4]

4. Supportability

To ensure proper logistical support for the first Fox systems fielded, the acquisition strategy stated that logistics support would be developed and fielded in two phases. The first phase would include contractor logistical support and would support the interim capability fielding in Europe. The second phase would be structured for worldwide fielding with organic logistical support. Although the Fox is an NDI acquisition, the acquisition strategy called for the maximum use of built-in-test equipment, line-replaceable units, and standard support, test, measurement, and diagnostic equipment. The use of these items is important, because the strategy called for the Fox to be incorporated into the standard Army logistics support structure. A detailed plan of how the Fox is to be supported is outlined in the Fox Integrated Logistics Support Plan (ILSP). [Ref. 17:p. 4-6]

5. Manufacturing and Production

The manufacturing and production section of the acquisition strategy directed that a rigorous Producibility Engineering and Planning (PEP) effort be provided to support the System Improvement Phase. Standard PEP clauses would be included in the contract. Manufacturing and production would be addressed at each review/decision point. No producibility or manufacturing investigations would be conducted for those items or subsystems being developed or adapted from commercial sources. In addition, Environmental Stress Screening and Reliability Growth Testing would be an integral part of the production effort. An in-house effort would be conducted to evaluate the producibility of the contractor-developed technical data packages (TDP). [Ref. 17:p. 6]

6. Test and Evaluation

The test and evaluation section of the acquisition strategy called for a test and evaluation program tailored to support the NDI acquisition strategy and to ensure that operational and technical tests were performed on the Fox. To meet this objective, the strategy listed the tests that would be conducted during each phase of the Fox acquisition. The test and evaluation section described these tests in the following manner. [Ref. 17:p. 7]

a. The "Shoot-off" Evaluation

This testing is designed to evaluate the candidate systems against defined mission-essential criteria based on the ROC to allow selection of one system, and to provide sufficient evaluation for initiation of the Interim Production of 48 items. [Ref. 17:p. 7]

b. System Improvement

An Engineering Design Test (EDT) would be performed to demonstrate the improved system's ability to meet the performance requirements of the contract and demonstrate item reliability. A Production Qualification Test (PQT) would be performed to evaluate the system under the environmental conditions specified in the ROC: system durability, off-road mobility, swimming capability, collective protection, survivability, Electro-Magnetic Compatibility/Vulnerability, detection capability, communications performance, and reliability. An Initial Operational Test and Evaluation (IOT&E) would be performed to assess the ability of the NBCRS crewman to employ the system. [Ref. 17:p. 8]

c. Production

During this phase, a first article test (FAT) would be conducted to evaluate the NDI system to allow fielding on a limited production basis and to allow full materiel release of NBCRS that satisfied all ROC requirements. Follow-on Operational Test and Evaluation (FOT&E) may be conducted on full-capability production items in the event

that training, tactics, doctrine, and support packages must be verified prior to system fielding. [Ref. 17:p. 8]

7. Cost Growth and Drivers

As with any acquisition program, the cost of the Fox is a critical issue. There are no predecessor systems to use as a basis for projecting cost growth. Potential cost growth could be due to the sole-source manufacturing of the vehicle, NDI components, and data rights negotiations. [Ref. 17:p. 9]

8. Technical Risk

The acquisition strategy assessed the technical risk of the program to be moderate because the design of the NBCRS incorporated proven technology using established detectors and militarized commercial equipment and a mature chassis. [Ref. 17:p. 9]

9. Safety and Health

Safety and health issues are important in the Fox Program, just as they are in any acquisition program. The Fox acquisition strategy stated that health programs be in compliance with MIL-STD-882B and Health Hazard Assessment requirements be planned to ensure that safety and health concepts were incorporated into the design and operation of the NBCRS. The strategy also stated that a system safety and hazard prevention program would be implemented for the life of the system. [Ref. 17:p. 9-10]

10. Standardization and Interoperability

Standardization and interoperability issues present a special challenge for the Fox Program. The Fox acquisition strategy stated that the NBCRS development program would include a complete Rationalization, Standardization, and Interoperability (RSI) effort with deliverable reports. [Ref. 17:p. 10]

11. Survivability and Endurance

The acquisition strategy addressed survivability and endurance by directing that several measures be taken. First, the NBCRS is mission-essential and therefore both Nuclear (AR 70-60) and NBC Contamination Survivability (AR 70-71) would be required. Second, Nuclear and NBC Contamination Survivability would be assessed and/or tested

as part of technical testing for NBCRS. Third, an assessment of live-fire survivability would be made to determine whether actual live-fire testing is required. [Ref. 17:p. 11]

12. Soldier-Machine Interface

Manpower Personnel Integration (MANPRINT) was an important part of the Fox Program, even though it was an NDI strategy. One of the major goals of the program was to reduce the current soldier-machine interface requirements and related mission performance burdens. A MANPRINT risk assessment would be conducted at the start of the program and updated prior to each milestone review. Analysis would be conducted to predict system demands on the future personnel inventory and identify unsupported requirements. [Ref. 17:p.12]

The production and fielding of all U.S. production systems is complete. These systems were fielded to units in Forces Command, United States Army Europe, and Korea. The fleet size is 113 units, including the 65 units fielded for Operation Desert Storm. Contractor Logistics Support for direct support, general support, and depot level will be required until FY01.

V. ANALYSIS AND LESSONS-LEARNED

A. INTRODUCTION

Acquisition in the 1990's can be best described as a complicated process embroiled in a multi-faceted environment. Besides understanding and implementing the plethora of regulations dealing with a normal acquisition, the Program Manager attempting to pilot a foreign NDI program must be intimately familiar with a sea of regulations, laws, directives, and international treaties dealing with foreign acquisition.

Additionally, the internal bias that may exist also affects the Program Office, further complicating the efforts to establish and then manage the acquisition of a system. These biases may range from the familiar "Not-Invented-Here" syndrome to fears of supply lines being cut off and fears of political instability in the countries supplying armaments and spare parts.

International acquisition is not only the purchase of military armaments and hardware in the international marketplace, it is also a highly-charged and political process, dealing not only with the military establishment of two or more countries, but with the bureaucracies of the countries involved. Dealing with these governing bureaucracies can be a very long process, even in a small and simple acquisition, let alone a program dealing with millions of dollars.

To determine why the Fox Program's NDI acquisition strategy was a success, both the factors that made the program successful and the shortcomings that occurred during the execution of the program were analyzed. These factors and shortcomings are the result of the execution of the program guided by its NDI acquisition strategy. From these factors and shortcomings, lessons-learned are identified. These lessons-learned are not based on quantitative analysis, but on a qualitative analysis of the Fox Program's foreign NDI acquisition and how it was implemented. The intent is to document the lessons-learned, not to draw conclusions about how well the Fox Program management personnel managed the program.

In the current environment of close scrutiny of defense acquisition by both Congress and the general public, the Department of Defense cannot afford to appear to be unable to learn from its past experience or to need to be taught the same lesson more than once. Certainly, acquisition managers want to learn from previous mistakes to avoid repeating them. Equally important, acquisition managers want to repeat "tried and true" techniques that work, to avoid "reinventing the wheel" on each new acquisition program.

The lessons-learned presented in this chapter are not all-inclusive, but are the significant ones identified from an analysis of the Fox Program. These lessons-learned are intended to help acquisition managers and their staffs in effectively managing future foreign NDI acquisition programs.

B. LESSONS-LEARNED

The Fox Program Management office was sent a questionnaire (Appendix D) to aid the author in the examination of the Fox Program. The significant lessons-learned from the examination of the Fox Program include the following:

- **Foreign NDI acquisition strategy works well and can be used successfully to acquire a weapon system.**

The Fox Program has shown that a weapon system can be successfully acquired by using a foreign NDI acquisition. The use of a foreign NDI acquisition allowed the Army to field a weapon system rapidly to fill the requirement for an NBC Reconnaissance System. The Fox is meeting cost, schedule, and performance requirements. This was accomplished by taking advantage of the NDI acquisition benefits and by overcoming NDI challenges.

- **The approval and support of Congress, DoD, and Army leadership is key to the success of a program.**

As with any acquisition program, the approval and support of high-level DoD leadership, Congress, and the users is essential to the successful acquisition and fielding of a weapon system. The Fox Program received approval and support from senior DoD leadership, Congress, and the Army because Congress effectively wrote the Fox Acquisition Strategy through their direction in the FY89 Authorization Bill. The Bill spelled out in detail how the Program would conduct the "shoot-off" and what the winner would get. The Program had additional support from the Congressional Representatives from Michigan and Alabama, as the work would be done in their districts. Essential to the process is to have a domestic prime contractor, with the foreign contractor as the principal subcontractor. This gets the local congressman behind the program and helps overcome the negative aspects of balance of payments and the "not-invented-here" syndrome.

The Fox Program had DoD backing when the original direction was provided by the then Under Secretary of the Army, Mr. Ambrose. The Fox had Army backing because it allowed one system to replace both the M113 forward version and the HMMWV rear area version NBC Reconnaissance Systems. The Fox allows the Army to recon for liquid chemical contamination at 45 km/hr in a safe, protected environment vice having a soldier in Mission Oriented Protective Posture (MOPP) IV walking 1 km/hr testing with M9 paper on a stick.

- **The NDI acquisition strategy must be tailored to the program.**

To be successful, an NDI acquisition strategy must be tailored to the program. This is important because, to take full advantage of NDI benefits, acquisition managers must be allowed to structure a program differently from a full-scale development program. In the Fox Program, program management officials ensured that the acquisition strategy outlined how the acquisition process would be tailored, and then, ensured that the program was effectively executed according to this strategy.

- **Market survey and knowledge are necessary.**

A complete and thorough market survey is important in the use of an NDI acquisition. The combat developer normally does not know what technology is available in the marketplace. The results of the market survey will indicate if the use of an NDI strategy is feasible. Without this information, the decision about whether an NDI strategy should be used cannot be made adequately. In the Fox Program, in-depth market research was key in justifying the ongoing U.S. effort and adopting the German-designed Fox. This investigation was essential in providing a valid justification for going off-shore rather than in-house or to a U.S. contractor. Market investigation also provides the knowledge that there is, or is not, an alternative system or approach out there that can better satisfy the needs of the soldier.

- **When using an NDI acquisition strategy logistical support planning must begin early.**

Though not peculiar to foreign acquisitions, logistics has been receiving increased attention from the research and development phases to system retirement. The logistics support cost of a system can often equal or exceed initial procurement costs. In its broadest sense, logistics is the Life Cycle Cost of a weapon system, viewing it from cradle to grave. With the increasing complexities of the systems, reduced budgets, and limited resources, it is essential that a new system be evaluated on an integrated basis. Logistics must be considered when evaluating the system during development to ensure balance is achieved between the prime mission equipment and its related support. With NDI systems, much of this analysis has already been done, but must be re-evaluated for hidden costs. Integral to this evaluation is the determination of who is to provide spares support and determining if spares are best procured domestically or from the original manufacturer. The following must also be addressed in evaluating the candidate system: test equipment, training of personnel, contractor support, initial provisioning, interim support period, publications, and transportation to the U.S. The economics of Life Cycle

Costing (as previously discussed) has serious implications for the cost of a program and as such should be addressed fully in all major program documents. Logistics for the Fox will be handled jointly by the contractor and the Army. In the Fox Program, acquisition managers realized they did not have adequate logistical support planning time so they used interim contractor support (ICS) until sufficient planning could be completed and a logistical support structure established. Due to the lack of planning time, the Fox Program has had problems, which have had to be solved via various work-arounds and compromises, some of which will have negative effects on the long-term operating and support costs of the system.

- **Acquisition managers must realize that NDIs may not meet all user mission requirements.**

Although NDIs save both time and costs, they may not meet all user needs. Performance trade-off analyses must be conducted during the process of deciding whether to acquire an NDI. During these analyses, acquisition managers must identify to the users what requirements may not be met, and if the decision is made to acquire an NDI that does not meet all critical user requirements, acquisition managers must develop a plan to address any shortcomings. The Fox Program did have several user requirements that were not initially met, but the acquisition managers developed a plan to ensure that they would be met at a later date. The plan called for the successful offerer to execute a System Improvement Phase (SIP) effort to meet the requirements in the Statement of Work (SOW) of the Request for Proposals (RFP) as supported by the Required Operational Capability (ROC) document and the Test and Evaluation Master Plan (TEMP). General Dynamics Land Systems Division and Thyssen Henschel will produce the improved system for worldwide fielding and will upgrade the interim production system.

- **NDIs allow the increased use of fixed-price type contracts that save both time and money.**

The General Accounting Office (GAO) has noted that because of the reduced risk to the Government, simpler contract procedures can be used for NDIs. These contract procedures include increased use of fixed-price type contracts. This was true for the Fox Program. Army acquisition managers were able to use an FFP production contract for the Fox that led to reduced risk and contract administration and management costs. This savings helped ensure program objectives were met.

- **Acquisition managers of foreign NDIs must be watchful of currency requirements.**

Contracts entered into for a foreign acquisition must be priced and paid for in local currency unless an international agreement provides for payment in U.S. dollars, or the contracting officer determines that such use would produce an inequitable or inappropriate situation. This caveat allows room for the program manager to determine, in concert with the contracting officer, whether the purchase of a system would best be done in local currency or in U.S. currency.

Original cost estimates for foreign NDI programs could decrease, or worse, increase, due solely to fluctuation of exchange rates. Obviously the Program Manager would not have sufficient information to predict such fluctuations at the beginning of a new system, but he or she must be aware of these changes. The Fox Program has been fortunate in that problems with currency fluctuations have been minor, and have largely balanced out. The Program had some worries during the production contract when the dollar declined sharply, but by the time invoices were received the dollar had recovered. On the R&D program safeguards involving currency futures were built in saving the program from such troubles.

- **Selection of a dedicated contractor is important to the accomplishment of program objectives.**

One advantage of using a NDI strategy is that the contractor usually has had some experience with the system before the contract is awarded. The Army's selection of General Dynamics Land Systems Division and Thyssen Henschel was a good decision because Thyssen Henschel had experience with the Fox. This previous experience enabled the contracting team of General Dynamics Land Division and Thyssen Henschel to deliver the Fox successfully.

- **Committed program management is critical.**

A committed program management team is important to the success of any program. Key program management personnel should be brought on board early and kept on the program for the duration of the program. This continuity will lead to reduced turbulence and greatly enhance the program. In the Fox Program, the staff has essentially remained constant from the initiation until now, with the exception of the loss of the military program manager after a three-year tour. That impact was greatly reduced by having a civilian deputy program manager and system managers who provided continuity for the new military Program Manager. The Fox has an outstanding staff who have voiced their reluctance to leave before finishing the program. This has been a tremendous advantage for the program. The program has also had great management support, in that management leaves the personnel alone and fosters the stability it has enjoyed.

- **Effective configuration control requires early planning.**

The configuration management plan should be developed early and should be updated to reflect changing requirements. The plan is used to document functional and physical characteristics of an item, to control changes to an item and its characteristics, and to record and report the change processing and implementation status. All configuration management plans should be reviewed regularly to determine if changes are necessary. Configuration management is a discipline that requires proper attention and

management at all levels. If configuration management is not conducted properly, up front, and early, the job of the Program Manager becomes even more difficult. The Fox Program has had numerous configuration control problems. These problems were exacerbated by the following: the urgent fielding of the system bought from the Germans for International Materiel Evaluation and then rapidly Americanized and fielded in Southwest Asia; the urgent fielding of 60 German gift systems, quickly Americanized (different from the International Materiel Evaluation Systems); the production and fielding of the 48 Interim Systems (different from either the International Materiel Evaluation Systems and the gift systems); and the development of the SIP (improved) system. The Program was further hampered with a problem of acquiring the End User Certificate for initial delivery of technical data from Germany at the beginning of the contract. The process for transfer of German data to the U.S. has met with several snags which has delayed the transfer. The Program does have a drawing package for information purposes. It has also obtained, through a Cooperative Logistics Agreement, equal rights in configuration management with the German Army. This agreement, per OSD, is the first of its kind in DoD history.

VI. CONCLUSION

A. CONCLUSION

The Program Manager is faced with an ever-changing environment in the acquisition of new systems. This is further complicated by the challenge of entering the foreign marketplace.

With the cost of modern weapons rising, and the Defense budget becoming smaller, the push for NDI programs continually increases. The economics of modern weapons development cries out for the expansion of multinational weapons development. The United States, being a latecomer to international weapons acquisition, will have to rush to catch up with its European counterparts.

In an effort to provide acquisition managers with lessons-learned about foreign NDI acquisition, this thesis has examined an example of a successful NDI acquisition program - the Fox Program. This thesis has focused on foreign NDI acquisition and how the Fox Program management personnel have used this type of acquisition to field an effective system. The Fox Program is considered a success because it provided a system that met the user's requirements and because it met program objectives.

From the analysis of the Fox Program, the factors that made it successful, and the Programs' shortcomings, it is clear that a foreign NDI can be used to acquire a weapon system. However, the use of a foreign NDI acquisition must be carefully implemented and managed.

B. SUMMARY OF LESSONS-LEARNED

A summary of the lessons-learned from the study of the Fox Program is listed below.

1. Foreign NDI acquisition strategy works well and can be used successfully to acquire a weapon system.

2. The approval and support of Congress, DoD, and Army leadership is key to the success of a program.

3. The NDI acquisition strategy must be tailored to the program.

4. Market investigation and knowledge are necessary.

5. When using an NDI acquisition strategy logistical support planning must begin early.

6. Acquisition managers must realize that NDIs may not meet all user mission requirements.

7. NDIs allow the increased use of fixed-price type contracts that save both time and money.

8. Acquisition managers of foreign NDIs must be watchful of currency requirements.

9. Selection of a dedicated contractor is important to the accomplishment of program objectives.

10. Committed program management is critical.

11. Effective configuration control requires early planning.

C. RECOMMENDATIONS

The military faces reduced budgets for the immediate future. Within a reduced funding level, the military must continue to maintain the ability to defeat identified threats. The Fox Program has shown that foreign NDI works, and the Army must make foreign NDI a viable part of its acquisition strategy.

From the examination of the Fox Program, the following recommendations are made:

1. The lessons-learned should be disseminated to current and future program management personnel, as well as to other DoD acquisition officials.

2. DoD acquisition management officials should ensure foreign NDIs are considered during the Concept Exploration and Definition Phase of each weapon system program.

3. Other foreign NDI programs should be examined to broaden the base of foreign NDI lessons-learned.

4. The lessons-learned should be disseminated to the Center for Army Lessons-Learned (CALL).

APPENDIX A. ACRONYMS

ACRONYM	FULL TITLE
ABN	Airborne
ACR	Armored Cavalry Regiment
ASARC	Army Systems Acquisition Review Council
ASL	Authorized Stockage List
BDE	Brigade
BOIP	Basis of Issue Planning
C^2I	Command, Control, and Intelligence
CAV	Cavalry
CBD	Commerce Business Daily
CBRS	Concept Based Requirement System
CE/D	Concept Exploration and Definition
CEP	Concept Evaluation Program
COMSEC	Communications Security
CUCV	Commercial Utility Cargo Vehicle
DA	Department of the Army
DAB	Defense Acquisition Board

DEM/VAL	Demonstration and Validation
DIV	Division
DoD	Department of Defense
DoDI	Department of Defense Instruction
DSMC	Defense Systems Management College
EMD	Engineering and Manufacturing Development
FAT	First Article Test
FDT&E	Force Development Test and Evaluation
FUE	First Unit Equipped
FY	Fiscal Year
GAO	General Accounting Office
GFE	Government Furnished Equipment
IEP	Independent Evaluation Plan
IFB	Invitation for Bids
ILS	Integrated Logistics Support
ILSP	Integrated Logistics Support Plan
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation

ISP	Interim System Production
JROC	Joint Requirements Oversight Council
LCPT	Lightweight Collapsible Pillow Tank
LID	Light Infantry Division
LRIP	Low-Rate Initial Production
LSA	Logistical Support Analysis
MAA	Mission Area Analysis
MANPRINT	Manpower Personnel Integration
MCS	Maneuver Control System
MOPP	Mission Oriented Protective Posture
MPL	Mandatory Parts List
MNS	Mission Need Statement
MOU	Memorandum of Understanding
MSE	Mobile Subscriber Equipment
NBC	Nuclear, Biological, and Chemical
NBCRS	Nuclear, Biological, and Chemical Reconnaissance System
NDI	Non-developmental Item
NET	New Equipment Testing

OCONUS	Outside Continental United States
OMB	Office of Management and Budget
O&O	Operational and Organizational
ORD	Operational Requirements Document
O/S	Operations and Support
OTEA	Operational Test and Evaluation Agency
P^3I	Pre-Planned Product Improvement
P/D	Production and Deployment
PEO	Program Executive Office
PLS	Palatized Loading System
PM	Program Manager
PMO	Program Management Office
PR	Procurement Request
R&D	Research and Development
RDT&E	Research, Development, Test, and Evaluation
RFP	Request for Proposals
ROC	Required Operational Capability
RTFL	Rough Terrain Forklift

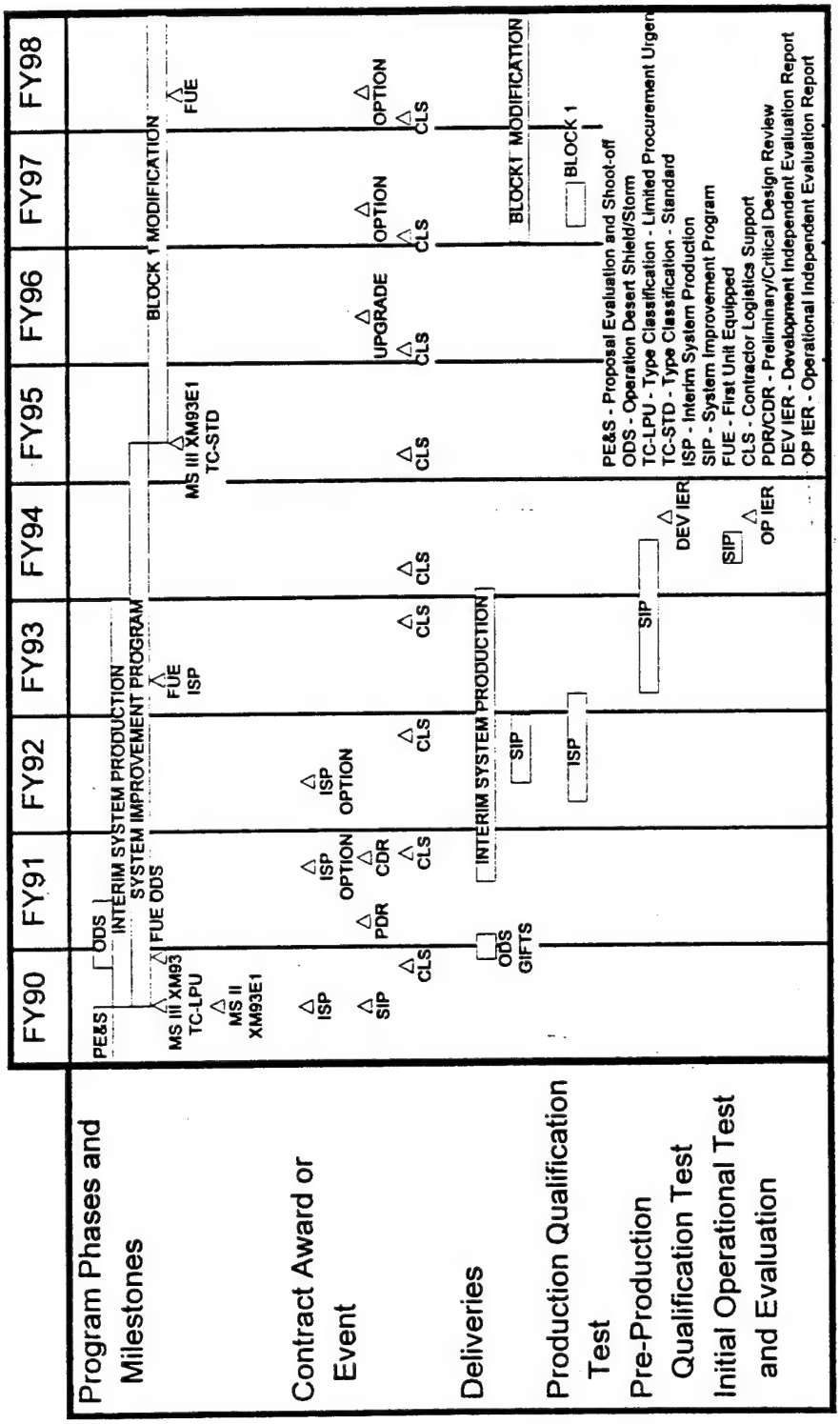
SECDEF	Secretary of Defense
SIP	System Improvement Program
SOW	Statement of Work
SSA	Source Selection Authority
SSAC	Source Selection Advisory Council
SSEB	Source Selection Evaluation Board
TDA	Table of Distribution and Allowances
TDP	Technical Data Package
TECOM	Test and Evaluation Command
TEMP	Test and Evaluation Master Plan
TOE	Table of Organization and Equipment
TRADOC	Training and Doctrine Command
USD(A&T)	Under Secretary of Defense (Acquisition and Technology)

APPENDIX B. FOX PROGRAM CHRONOLOGY

DATE	EVENT
October 1984	O&O Approved
August 1988	Acquisition Strategy Approved
September 1988	RFP Released
October 1988	ROC/JSOR Approved
December 1988	Proposals Received
December 1988	Proposal Evaluation Start
January 1989	ILSP Approved
January 1989	System Fabricate Start
May 1989	Shoot-off Test Start
July 1989	Shoot-off Test Complete
August 1989	Test & Evaluation Start
October 1989	Acquisition Plan Approved
December 1989	Test & Evaluation Complete
March 1990	Source Selection
March 1990	Development Contract Awarded (System Improvement)
August 1991	Critical Design Review
June 1992	First Prototype
December 1992	TTRR

January 1993	PPQT
March 1993	IOT&E
March 1995	MS III

APPENDIX C. XM93/XM93E1 NUCLEAR, BIOLOGICAL, CHEMICAL RECONNAISSANCE SYSTEM PROGRAM STRUCTURE



APPENDIX D. QUESTIONNAIRE SENT TO FOX ACQUISITION MANAGERS

1. Is the support from Congress, DoD, and Army leadership a key to the Program?
2. Is a thorough market investigation critical in using an NDI strategy?
3. Due to the shortened acquisition cycle of the Fox, how important is early logistical planning?
4. What type of contract was awarded? Has this type of contract proven useful?
5. Has the contractor been on schedule and within cost?
6. What problems and successes have the Program incurred with testing?
7. Have there been any problems with Technical Data Transfer?
8. Have there been continuity problems with key personnel?
9. Have there been any problems with configuration control?
10. What problems is the Program facing with financing?
11. Has the Program had any political problems?
12. Have there been any problems with "gold plating"?
13. Did the Program use "total package fielding"?

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